CONTINUOUS FIBER CERAMIC COMPOSITES

Project Fact Sheet

CFCC Natural Gas Infrared Burners

Benefits

Industries that use CFCC components in their applications will realize substantial energy, environmental and financial benefits. Natural gas infrared (IR) burners with CFCC emitters offer several important advantages over convection drying, electric infrared and current infrared technology.

- CFCC IR emitters have superior durability over current IR emitters.
- Convection drying relies on heating the air. Because infrared energy is radiant energy, it heats mainly the objects and not air. The result is minimal thermal loss and improved process efficiency.
- When compared to electric radiant heating, natural gas infrared is inexpensive, reliable and is a highly versatile, highly flexible technology which offers a wide range of system options for a variety of applications.

Applications

Natural gas infrared burners already have important applications in pulp and paper processing, paint drying and curing, plastics, and textile manufacture. In addition, the technology is beginning to make appearances in an increasingly large range of applications including wood finishing, food processing, and ceramics. CFCC emitters in IR burners could potentially be applied to all of these markets.

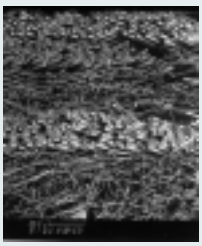
Fiber slurry and sol-gel impregnation process used to fabricate CFCC gas infrared burners

The U.S. Department of Energy's Office of Industrial Technologies (OIT) initiated the Continuous Fiber Ceramic Composite (CFCC) Program in 1992 as a collaborative effort between industry, National Laboratories, universities and government.

Through support of the CFCC Program, McDermott Technology is developing a fiber slurry and sol-gel impregnation process (a liquid precursor converted to solids) to produce CFCCs. Porous CFCC tubular components are made using a combined filament winding and vacuum forming process. This technique is ideal for oxide-based composite systems and allows scaling for cost-effective manufacturing operations.

Using this process, McDermott Technology, in partnership with several universities and the Institute of Paper Science and Technology, is developing spectrally matched CFCC emitters for infrared burners. Currently, there are many suppliers of natural gas-fired infrared heating systems for various industrial applications. However, these systems generally use metallic or monolithic ceramic emitters that are limited in operating temperature and IR spectral control. Recent research suggests that significant improvements in paper drying and other industrial thermal processes using gas-fired IR heaters may be achieved by tailoring the IR spectrum emitted by the heater. Based on research at McDermott, it appears that CFCC emitters will be able to operate at much higher temperatures than current IR emitters and have superior durability. Thus, CFCC emitters having tailored emission spectra should result in significant improvements in thermal efficiency and heating rates (productivity).

Natural Gas Infrared Burner



Cross-sectional view (left) of a gas infrared burner (right).

Project Description

Goal: The goals of this project are to: 1) develop functional CFCC components, using the sol-gel impregnation process, for application in gas infrared burners; and 2) demonstrate processing methods suitable for cost-effective manufacturing.

Higher IR radiant power output and improved heat transfer to paper webs will be the key measures of success for McDermott's emitter. Structural integrity and operating life (durability) will also be important. Success with the initial studies could lead to expanded testing.

As exhibited by this project, the CFCC Program is addressing the critical need for advanced materials that are lighter, stronger, and more corrosion-resistant than metals. The Program strives to advance processing methods for reliable and cost-effective ceramic composite materials to a point at which industry assumes the full risk of development and commercialization. The long-term strategy is to develop the primary processing methods for reliable and cost-effective fabrication of CFCCs and to perform application-specific testing which will meet the needs of a wide range of energy saving applications in industry. These industries include: power generation, agriculture, aluminum, steel, chemicals, forest products, glass, metal casting, mining and refining.

Progress and Milestones

- Identified initial emitter compositions to match the spectral emittance to a paper drying application.
- Produced chopped rare earth fibers by the spinning and "relic" process.
- Successfully modified hot gas filter fabrication method to produce flat emitter structures.
- Developing vacuum forming fabrication method as potential low cost fabrication approach.
- Installed laboratory burner test stand and initiated preliminary emitter testing.
- Continuing research support through mechanical testing and structural modeling.
- Evaluating emitter performance using a unique paper drying test facility.
- Field testing of IR burners to be performed at an industrial site.

Project Partners

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February 1999